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ABSTRACT

This monograph is a test of graphing and graph interpretation skills which assesses performance on all the skills of graphing which are contained in the AAAS program, Science - A Process Approach. The testing includes construction of bar graphs, interpreting information on graphs, the use of the Cartesian coordinate system, making predictions from plotted data, calculating rate of change and determining coordinates of points. No information or directions are given or suggested. (EB)

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TEST OF GRAPHING AND GRAPH INTERPRETATION SKILLS

By

J. HERMANN

June 30, 1973

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The following test of graphing and graph interpretation skills assesses performance on all the skills of graphing which are contained in the AAAS program, Science- A Process Approached.

J. Herrmann

10/25/72

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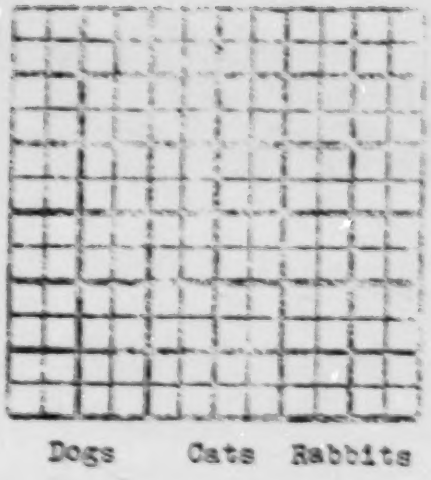
Construct a bar graph with a numerical vertical scale and a nominal horizontal scale.

1. A student conducted a survey to determine the number of dogs, cats, and rabbits owned by each member in a class of 30 students. The results of the survey are shown in the following table.

Pet Animal	Number Owned
Dogs	24
Cats	12
Rabbits	4

On which of the following grids would you begin to construct a bar graph of the above survey?

1.



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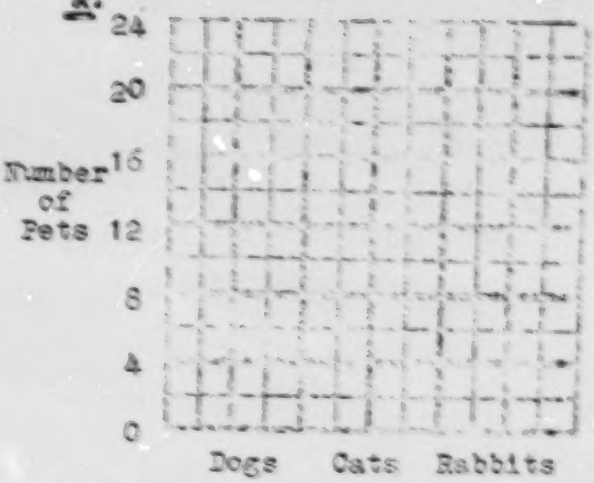
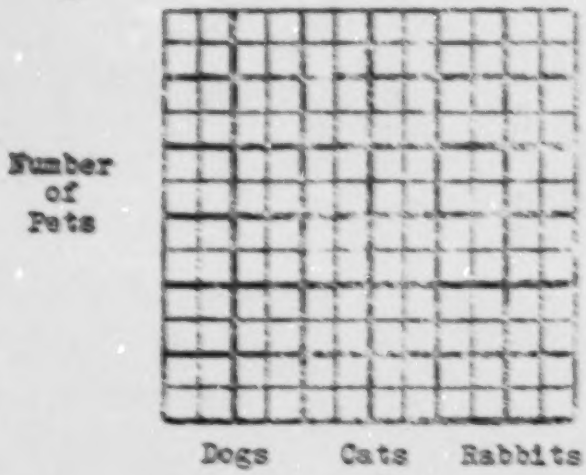
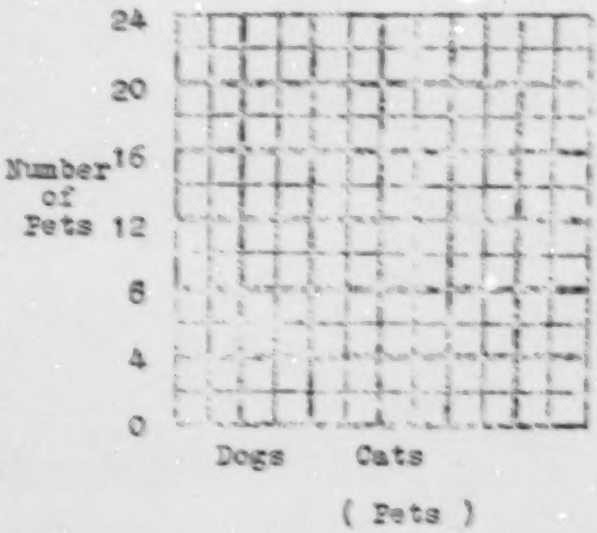


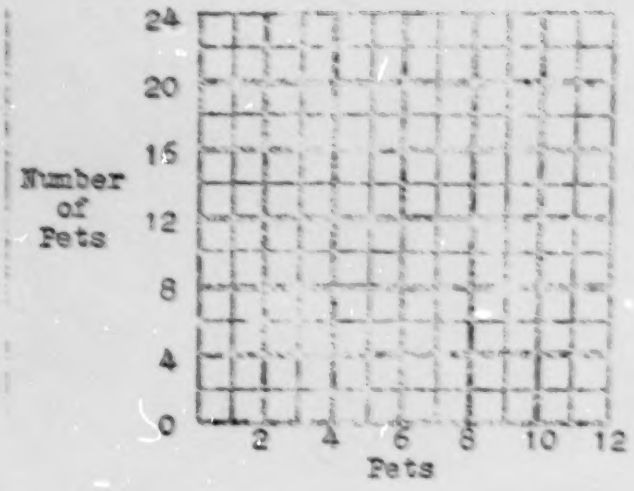
3.


Number of Pets
Dogs
Cats
Rabbits

4.

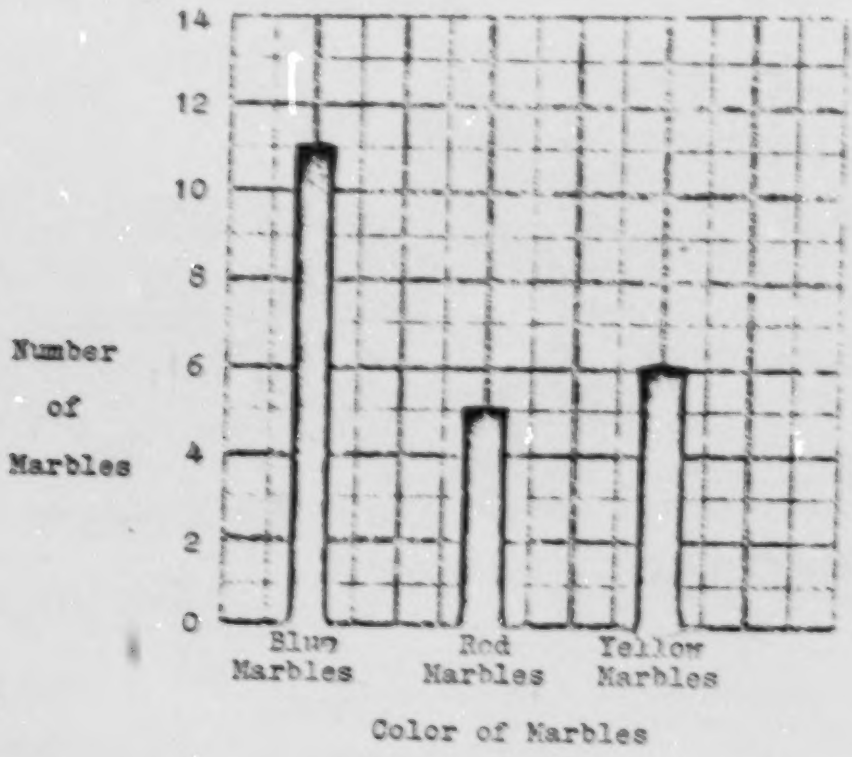

24
20
16
12
8
4
0
Number of Pets
Dogs
Cats
(Pets)

5.


24
20
16
12
8
4
0
Number of Pets
2
4
6
8
10
12
Pets

Identify quantities represented by bars on a given bar graph.

2. A student made a bar graph showing the number of blue marbles, red marbles, and yellow marbles that were in a box. Refer to the following bar graph.

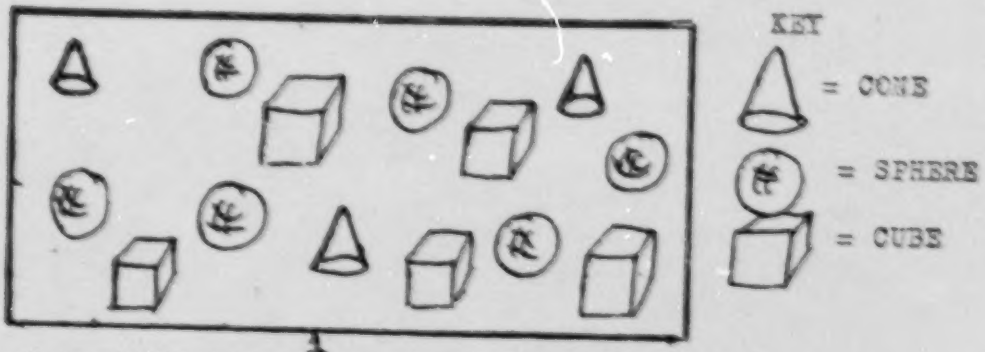


How many blue marbles were in the box according to the bar graph?

1. 5 marbles
2. 6 marbles
3. 11 marbles
4. 10 marbles
5. 12 marbles

Construct a bar graph which represents the quantities of specific items from a given set of different objects.

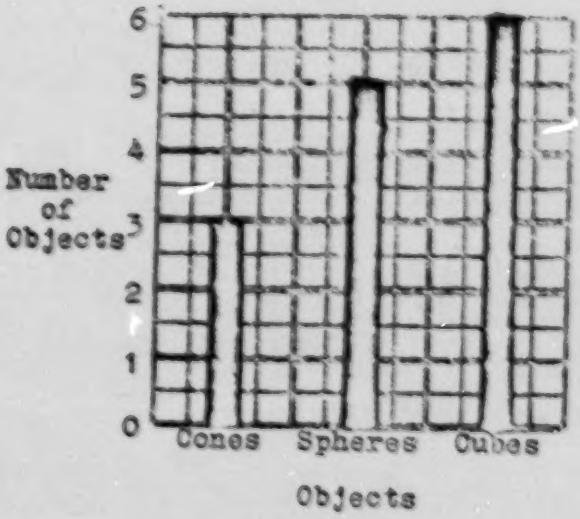
3. A student made a bar graph showing the number of cones, spheres, and cubes located in a given box. See figure 1.



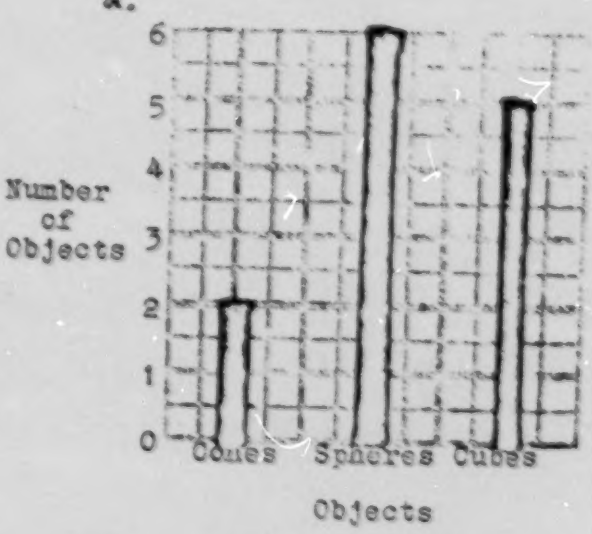
1

Which of the following bar graphs correctly represents the number of objects located in the box?

1.



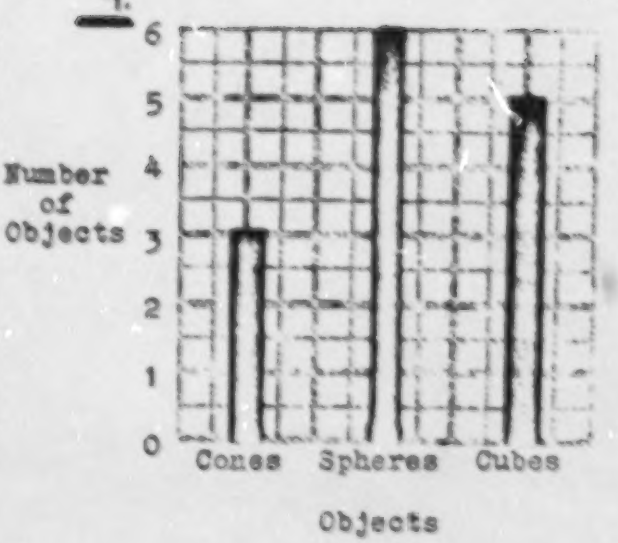
2.



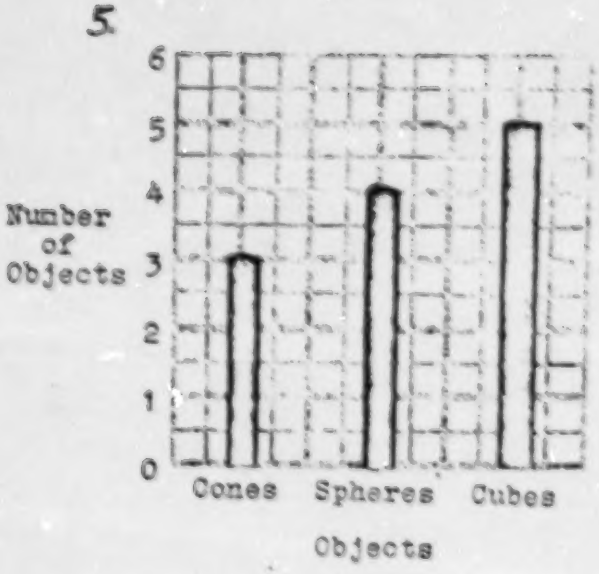
3

6
5
4
3
2
1
0
Number of Objects
Cones
Spheres
Cubes
Objects

4.


6
5
4
3
2
1
0
Number of Objects
Cones
Spheres
Cubes
Objects

5

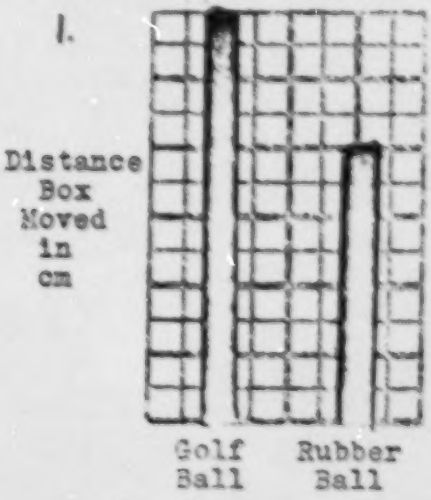

6
5
4
3
2
1
0
Number of Objects
Cones
Spheres
Cubes
Objects

Construct a bar graph which represents the data from a given scientific investigation

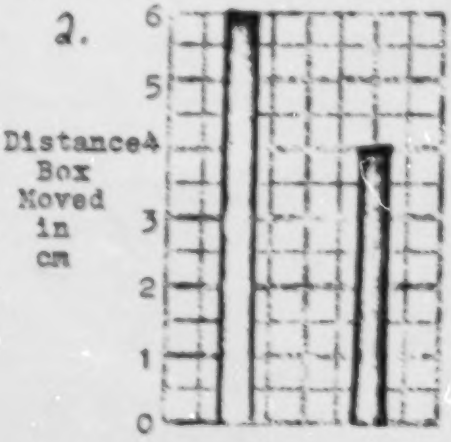
4. In an experiment on collisions, a student let a golf ball and a rubber ball roll down a board set on an angle in order to collide with a cardboard box. The cardboard box moved 6 centimeters when it was struck by a golf ball and it moved 4 centimeters when it was struck by the rubber ball.

Which of the following bar graphs best represents a proper graph of the results in the above experiment?

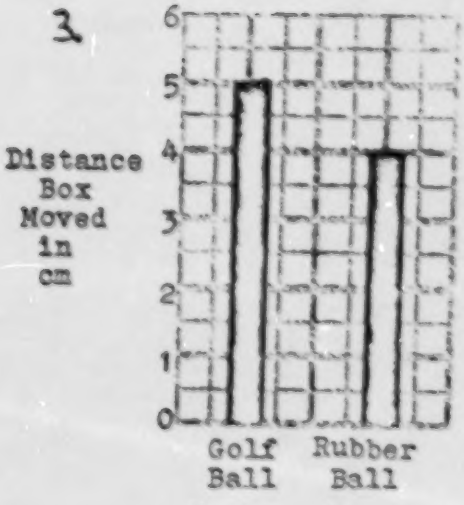
1.



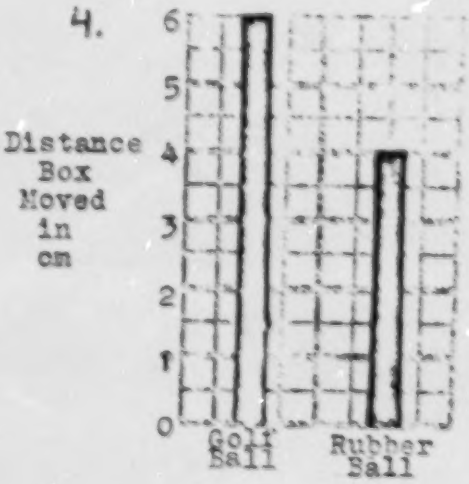
2.



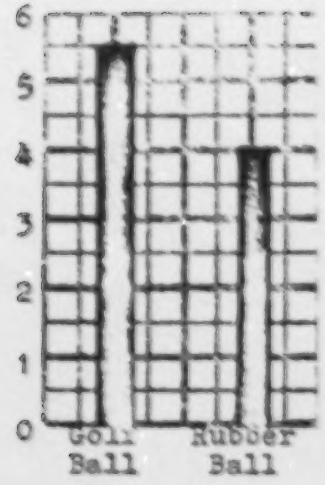
3.



4.



5.



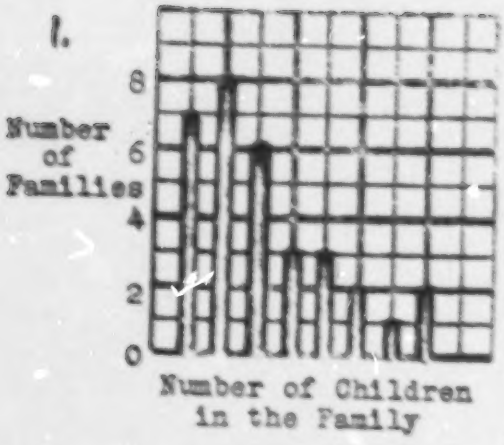
Construct a bar graph with an origin, a numerical vertical scale, and a numerical horizontal scale.

5. Each of 32 students in a class was asked to record the number of children in their family. The results were collected and recorded in the chart below.

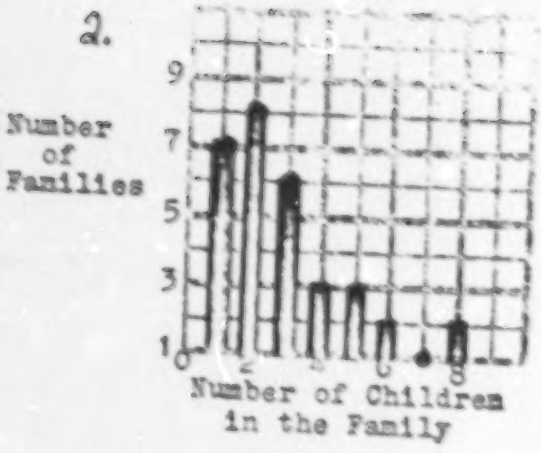
Number of Children in the Family	Number of Families
1	7
2	8
3	6
4	3
5	3
6	2
7	1
8	2

Which of thefollowing graphs best represents a proper graph of the above information?

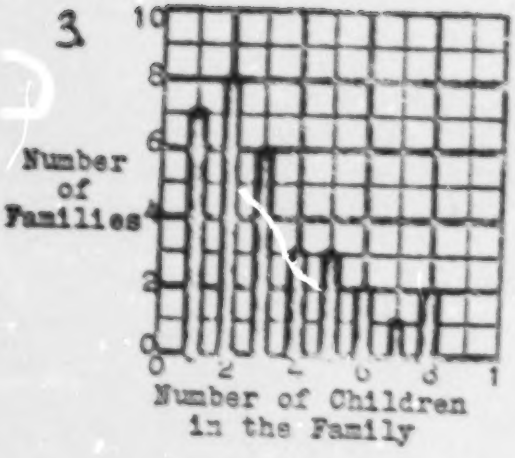
1.


Number of Families
0
2
4
6
8
Number of Children in the Family

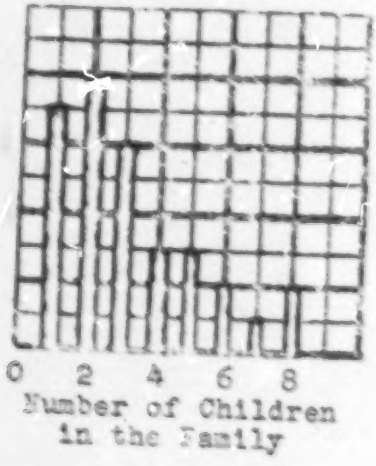
2.


Number of Families
1
3
5
7
9
Number of Children in the Family

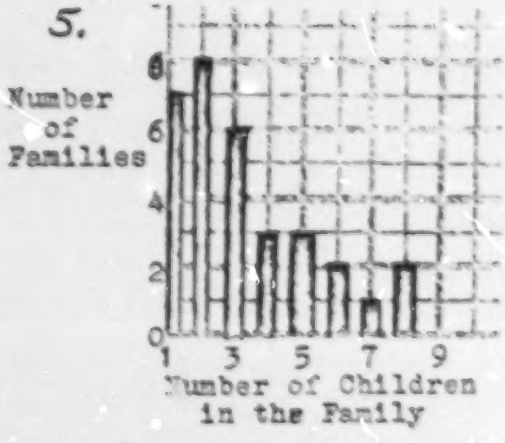
3.


Number of Families
Number of Children in the Family

4.


0 2 4 6 8
Number of Children in the Family

5.


Number of Families
0
2
4
6
8
1 3 5 7 9
Number of Children in the Family

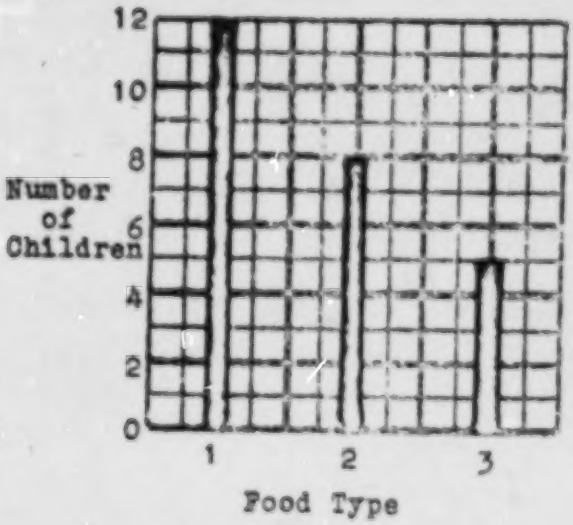
Construct the appropriate type of bar graph for any frequency distribution.

6. A survey conducted in a class of 25 students gave the following data on food preferences.

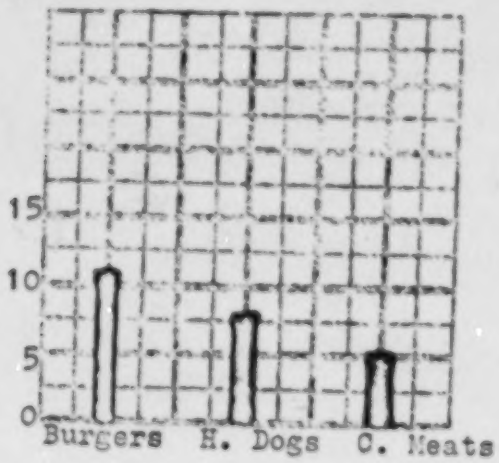
Food Preference		
Hamburgers	Hot Dogs	Cold Meats
12 Children	8 Children	5 Children

Which of the following bar graphs best represents a proper graph of the above survey?

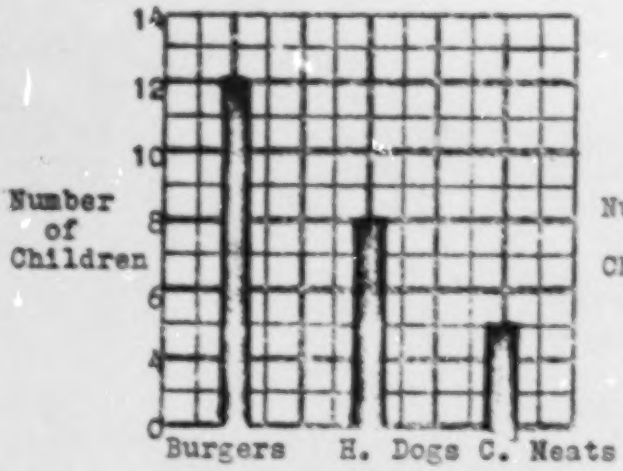
1.



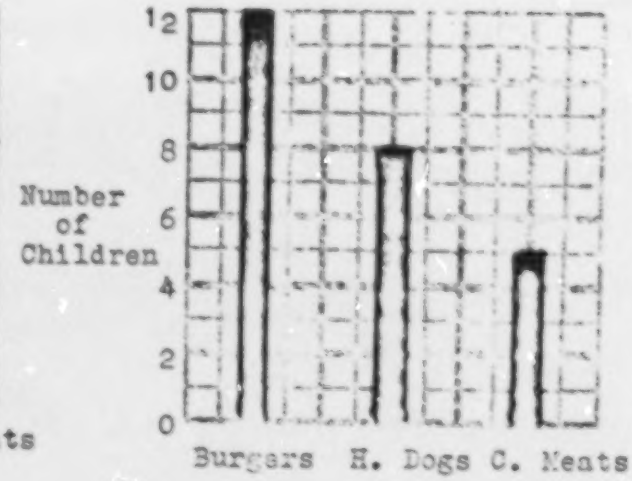
2.



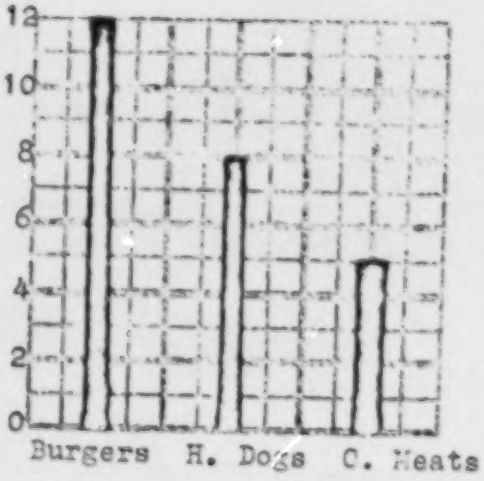
3.


Number of Children
14
12
10
8
6
4
0
Burgers
H. Dogs
C. Meats

4.

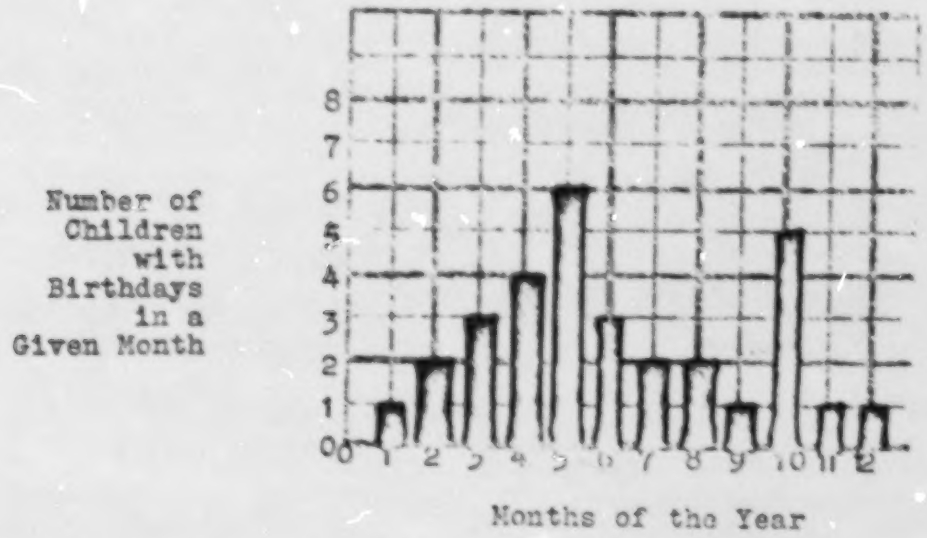

Number of Children
12
10
8
6
4
2
0
Burgers
H. Dogs
C. Meats

5.


12
10
8
6
4
2
0
Burgers
H. Dogs
C. Meats

Construct a frequency distribution from any type of bar graph.

7. The following bar graph was made to show the distribution of birthdays according to the months of the year for a class of 31 students.



Which of the following frequency distributions properly represents the data on the above bar graph?

1. Months of the Year 1 2 3 4 5 6 7 8 9 10 11 12

   Number of Children with Birthdays in a Given Month 1 2 3 5 6 3 2 2 1 5 1 1

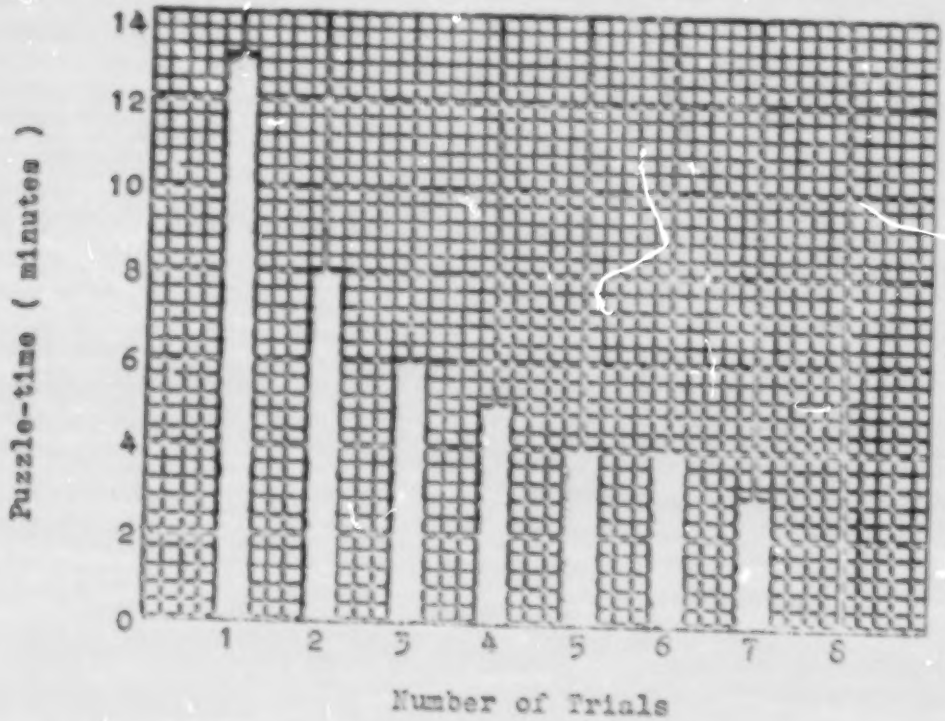
2. Months of the Year 1 2 3 4 5 6 7 8 9 10 11 12

   Number of Children with Birthdays in a Given Month 1 2 3 4 6 3 2 2 1 5 1 1

3.	Months of the Year	1	2	3	4	5	6	7	8	9	10	11	12
	Number of Children with Birthdays in a Given Month	1	3	4	5	6	3	2	2	1	5	1	1
4.	Months of the Year	1	2	3	4	5	6	7	8	9	10	11	12
	Number of Children with Birthdays in a Given Month	1	2	3	4	6	4	2	2	1	5	1	1
5.	Months of the Year	1	2	3	4	5	6	7	8	9	10	11	12
	Number of Children with Birthdays in a Given Month	1	2	3	4	6	3	2	2	1	5	1	1

Distinguish between quantities shown on a bar graph and identify comparisons such as greater than, less than, greatest, and least.

8. Two children wanted to find out if they could put a jigsaw puzzle together faster if they practiced. Each time one of them worked the puzzle the other watched the clock and recorded the time from start to finish. This was called puzzle-time. The puzzle-times for seven trials are shown in the following graph for one of the children.



What was the longest time required to put the puzzle together?

1. 12 $\frac{1}{2}$ minutes
2. 12 minutes
3. 14 minutes
4. 13 minutes
5. 12.2 minutes

Determine the quantitative difference between any two bars represented on a bar graph.

9. From the graph on puzzle-time, by how many minutes did the puzzle-time change between Trial Two and Trial Three?

   1. 1 minute
   2. ½ minute
   3. 2 minutes
   4. 4 minutes
   5. 5 minutes

Identify rates of change in a bar graph.

10. From the graph on puzzle-time, how many different rates of change are represented on the graph?

   1. 6 different rates
   2. 5 different rates
   4. 4 different rates
   5. 3 different rates

Distinguish between maximum and minimum rates of change from data presented in a bar graph.

11. What two sets of trials represent the maximum and minimum rates of change, in that order, from the puzzle-time graph?

   1. 1,2 and 3, 4
   2. 1,2 and 5,6
   3. 5,6 and 1,2
   4. 4,5 and 1,2
   5. 1,2 and 4,5

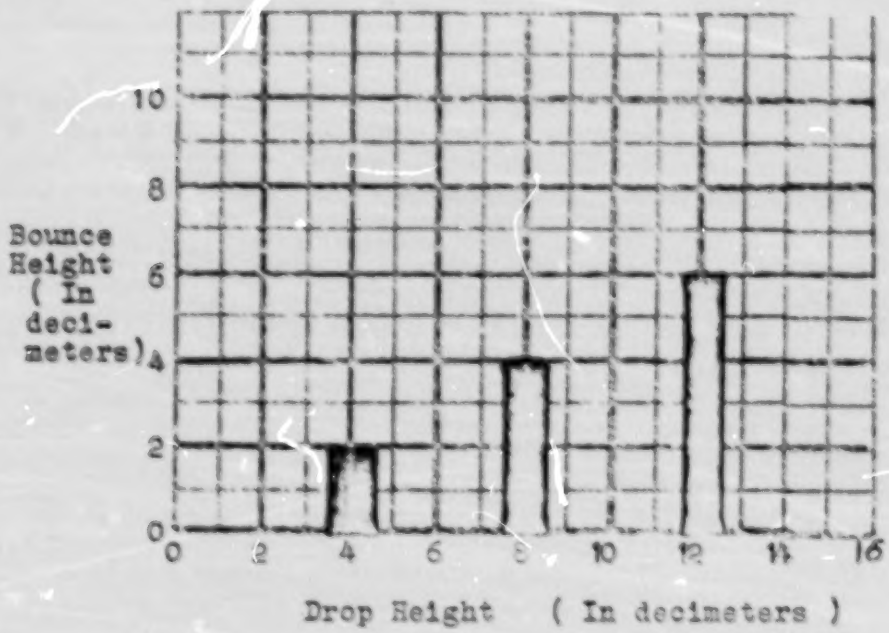
Compare rates of change from data presented in a bar graph.

12. What rate of change is equal to the rate of change which takes place between trials 4 and 5 on the puzzle-time graph?

   1. rate between 1 and 2
   2. rate between 2 and 3
   3. rate between 3 and 4
   4. rate between 5 and 6
   5. none of these

Make extrapolations with data from a single bar graph or from many bar graphs.

13. In an experiment, a student dropped a rubber ball from three different heights and recorded the maximum height which the ball reached after the first bounce. The data is presented in the bar graph shown below.



Predict from the above graph what the bounce height would be if the rubber ball were dropped from a height of 16 decimeters.

1. 8 decimeters
2. 10 decimeters
3. 8 ½ decimeters
4. 7 decimeters
5. 7 ½ decimeters

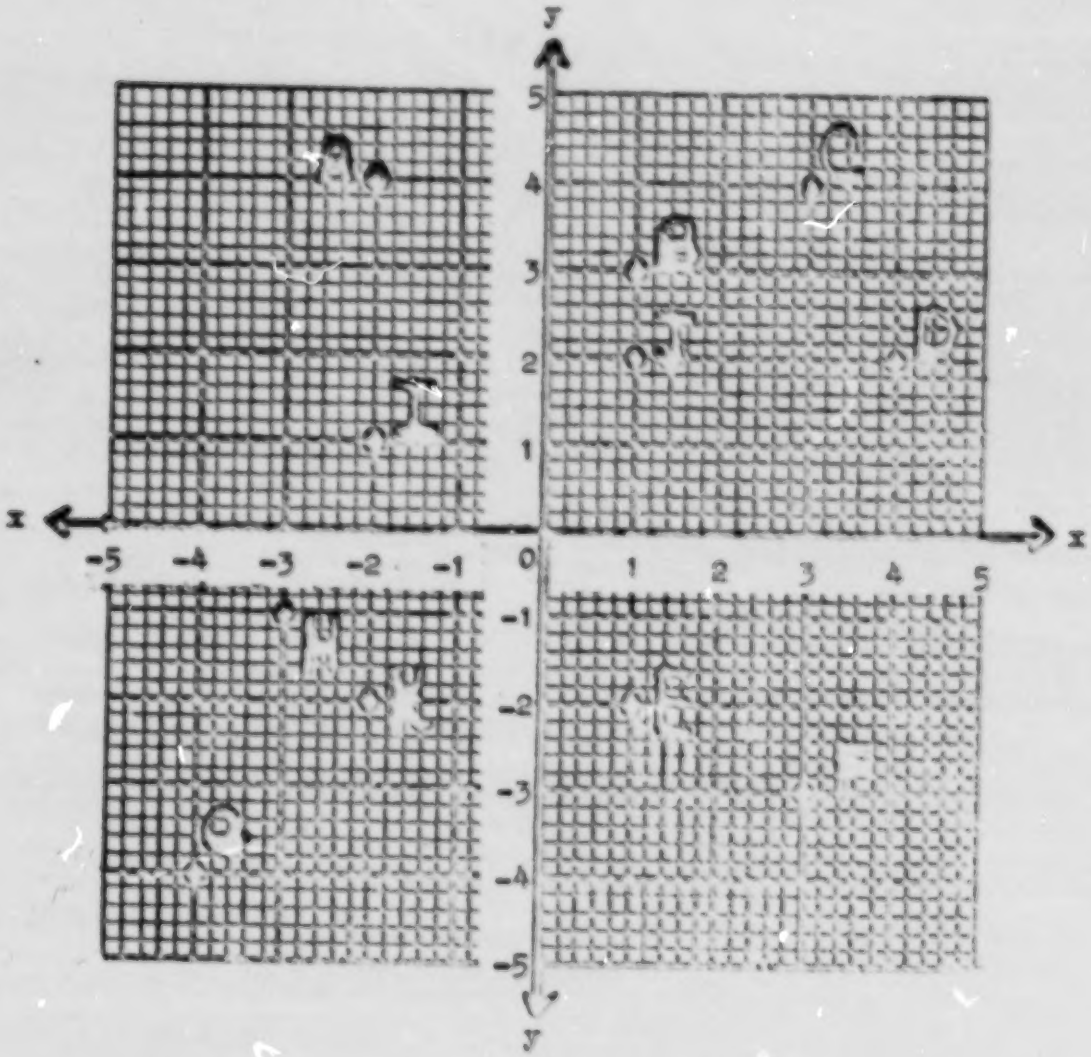
Make interpolations with data from a bar graph.

14. Predict from the preceding graph what the bounce height would be if the rubber ball were dropped from a height of 6 decimeters.

    1. 2 ½ decimeters
    2. 3 ½ decimeters
    3. 2. 4 decimeters
    4. 3.2 decimeters
    5. 3 decimeters

Determine the coordinates of points located on a Cartesian coordinate system

15. Determine the coordinates of point " A " on the graph below. Make your selection from the answers supplied below the graph.



1. 4, 2
2. 2, 4
3. -4, 2
4. -2, 4
5. -2, 3

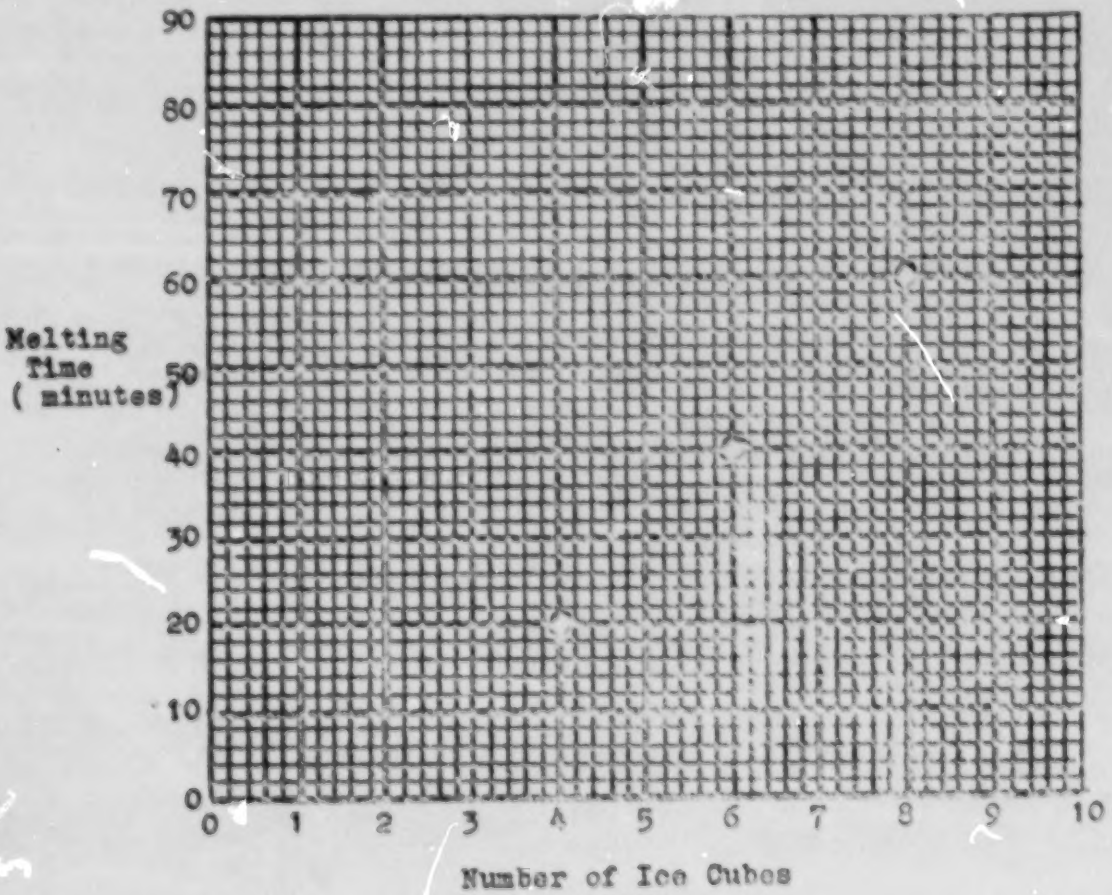
Locate points on the Cartesian coordinate system given the coordinates.

16. What letter is on the point (1, -2) on the preceding graph?

    1. E
    2. H
    4. I
    5. J

Make interpolations from points located on a graph.

17. In an experiment on heat transfer a student placed 4, 6, and 8 ice cubes of equal mass into three beakers containing equal amounts of water at the same temperature. The melting times for each group of ice cubes were recorded and shown in the graph below.



Predict how long it would take 7 ice cubes to melt under the same conditions.

1. 42 minutes
2. 46 minutes
3. 50 minutes
4. 54 minutes
5. 58 minutes

Make extrapolations from points located on a graph.

18. Predict how long it would take 3 ice cubes to melt under the same circumstances as indicated in question 17.

1. 1 minute
2. 2 minutes
3. 7 minutes
4. 10 minutes
5. 13 minutes

Place manipulated variables on the horizontal scale of the Cartesian coordinate system and place responding variables on the vertical scale of the same graph.

19. In an investigation involving predictions, 20, 40, 60, and 80 drops of water are added to a glass cylinder. A piece of centimeter tape was added to the outside of the cylinder so that the water level could be measured. The water was at a constant temperature of 20 degrees centigrade. A chart of the data is given below.

Manipulated Variable Number of Drops	Responding Variable Height of Water (cm)
0	13.7
20	14.2
40	14.8
60	15.3
80	15.8

According to convention, on which axis should each of the above variables be plotted?

1. Vertical Axis (Number of Drops)
   Horizontal Axis (Height of Water)

2. Vertical Axis (Height of Water)
   Horizontal Axis (Number of Drops)

3. Vertical Axis (Number of Drops)
   Horizontal Axis (Water Temperature)

4. Vertical Axis (Water Temperature)
   Horizontal Axis (Number of Drops)

5. Vertical Axis (Height of Water)
   Horizontal Axis (Water Temperture)

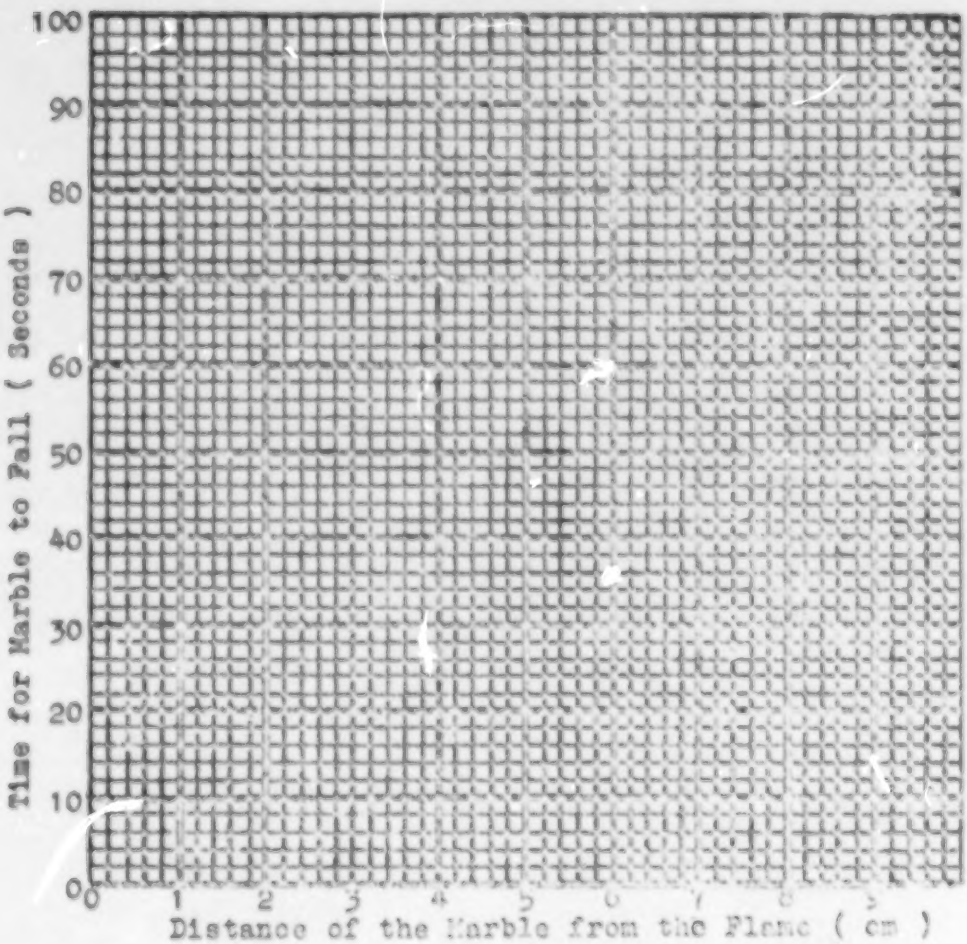
Determine the scales of measurement for the axes of the Cartesian coordinate system which are appropiate for the data.

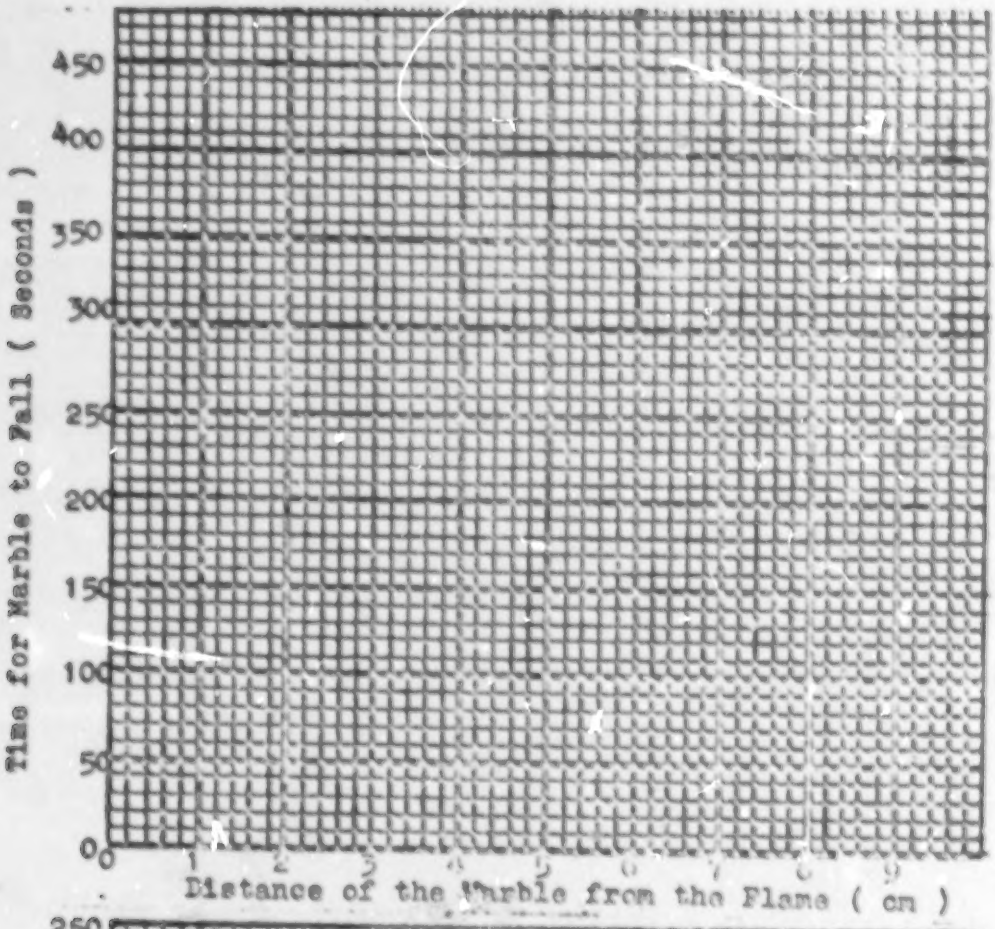
20. In an experiment on heat conduction , four marbles were attached to an aluminum rod with a small piece of wax. The marbles were spaced exactly two centimeters apart. The rod was then placed into a flame exactly two centimeters from the first marble. The time for each marble to fall from the rod was recorded. The experiment was repeated for a steel and a brass rod. The data is presented in the chart below.

Marble Number	Distance from Flame (Centimeters)	Time to Drop (Seconds)		
		Aluminum	Steel	Brass
1	2	9	10	7
2	4	17	33	23
3	6	29	75	44
4	8	45	145	62

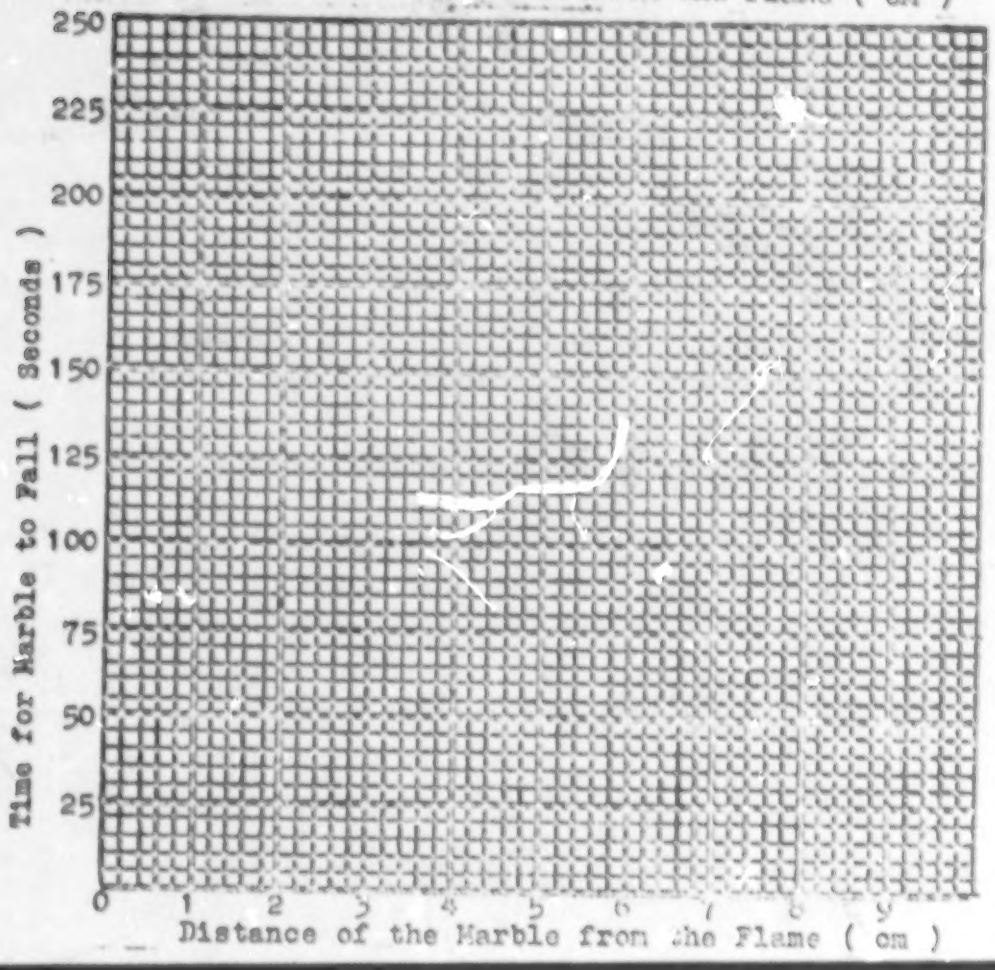
Which of the following grids has the most appropriate horizontal and vertical scales for making a graph of the above data?

1.

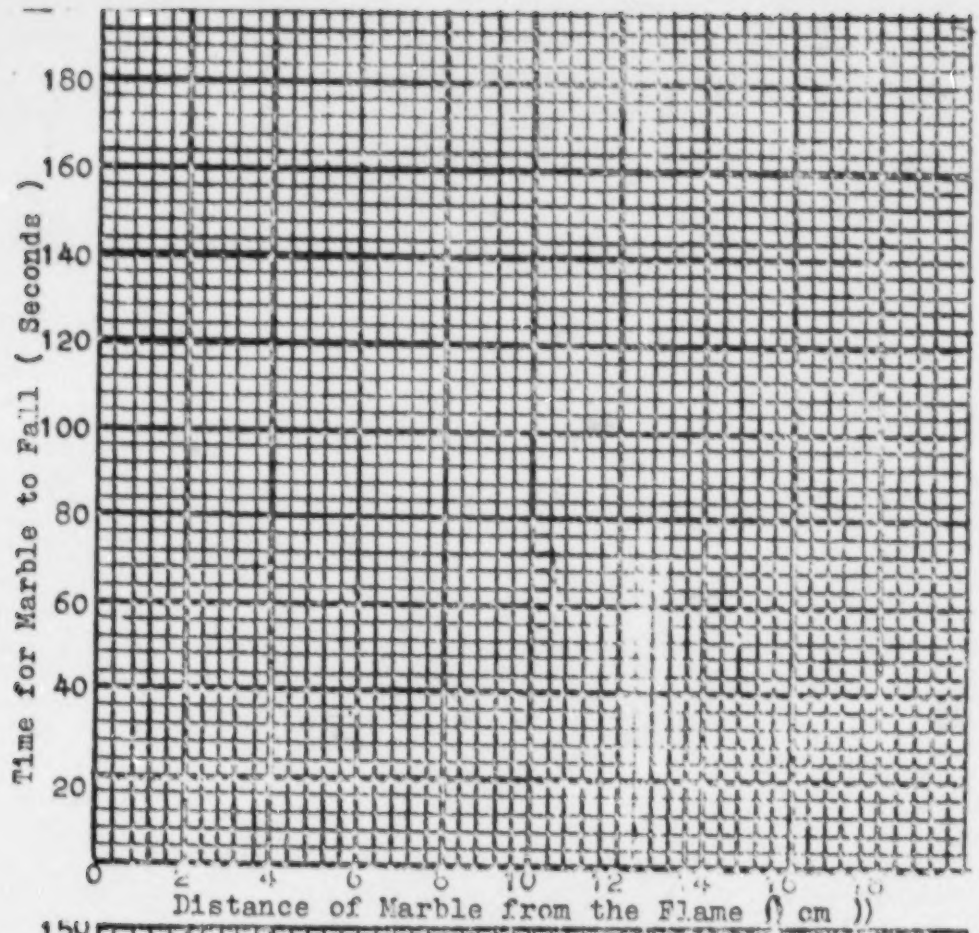



Time for Marble to Fall (Seconds)
450
400
350
300
250
200
150
100
50
0
0 1 2 3 4 5 6 7 8 9
Distance of the Marble from the Flame (cm)

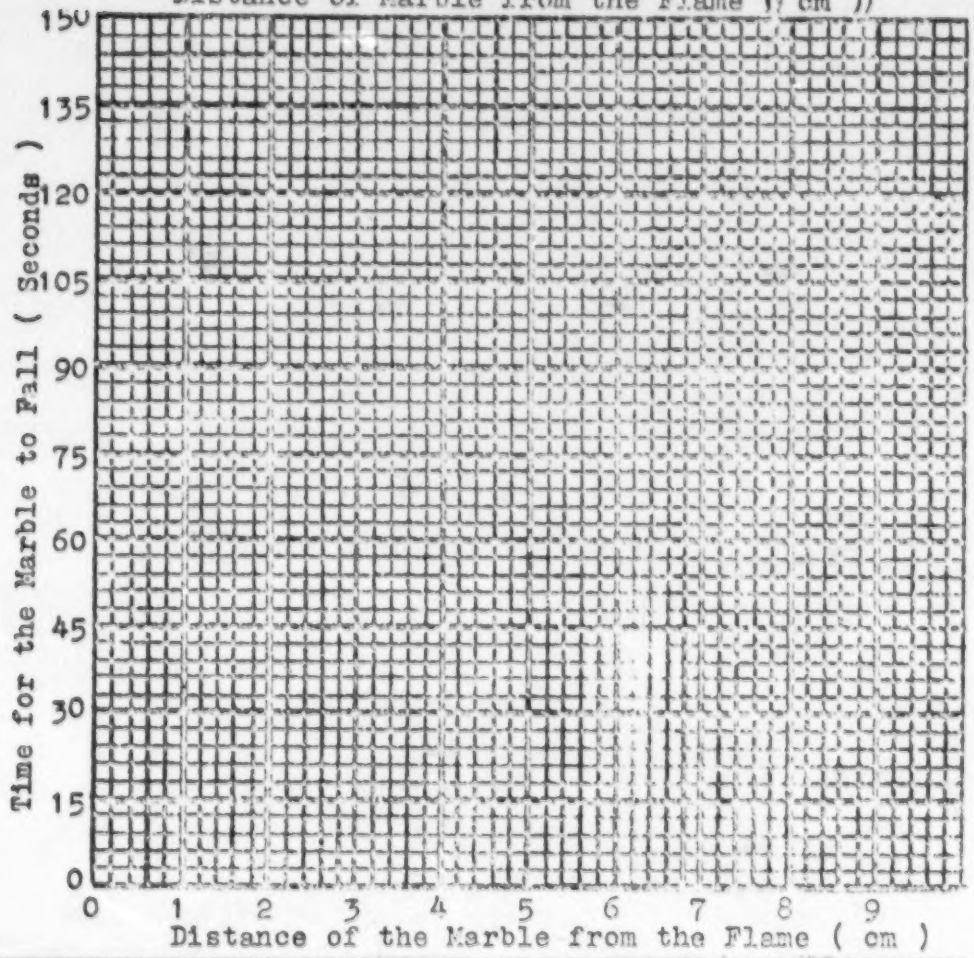
3


Time for Marble to Fall (Seconds)
250
225
200
175
150
125
100
75
50
25
0
0 1 2 3 4 5 6 7 8 9
Distance of the Marble from the Flame (cm)

4.


Time for Marble to Fall (Seconds)
180
160
140
120
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
Distance of Marble from the Flame (cm))

5.

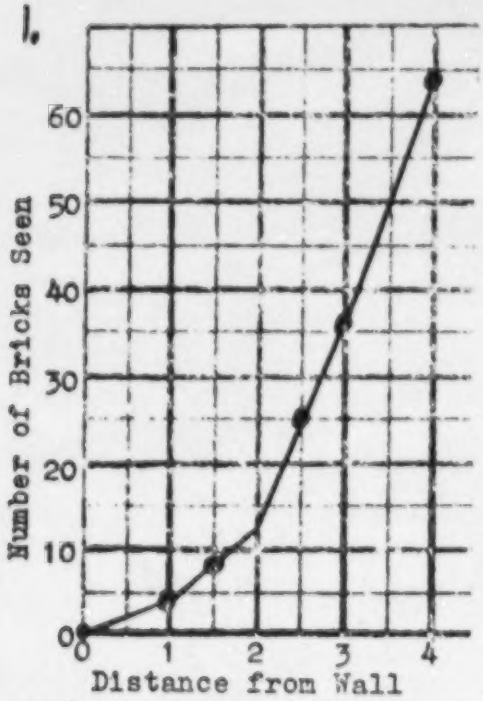

Time for the Marble to Fall (Seconds)
150
135
120
105
90
75
60
45
30
15
0
0
1
2
3
4
5
6
7
8
9
Distance of the Marble from the Flame (cm)

Connect the plotted points on a graph with line segments or a smooth curve.

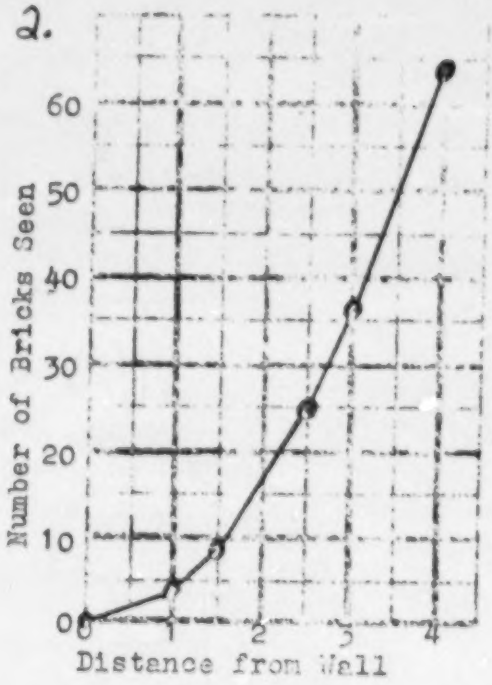
21. In an experiment on the field of vision, a student made five observations through a special viewing tube of a brick wall from different distances. The data were recorded and points were plotted on a graph.

Which <u>two</u> of the following graphs show the proper method of sketching in a curve from points on a graph?

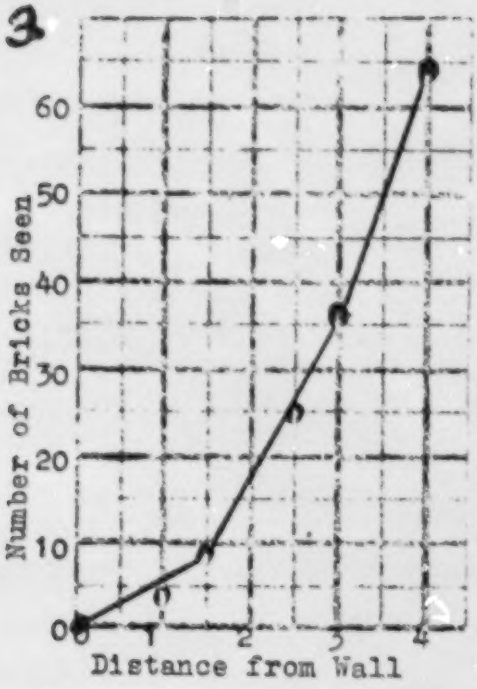
1.



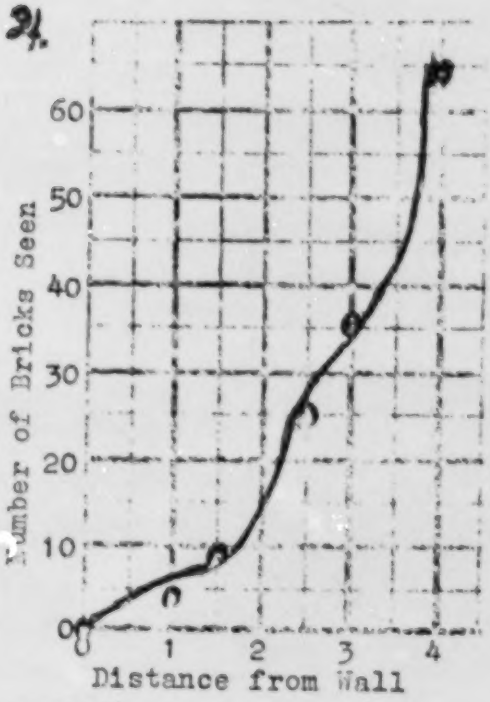
2.



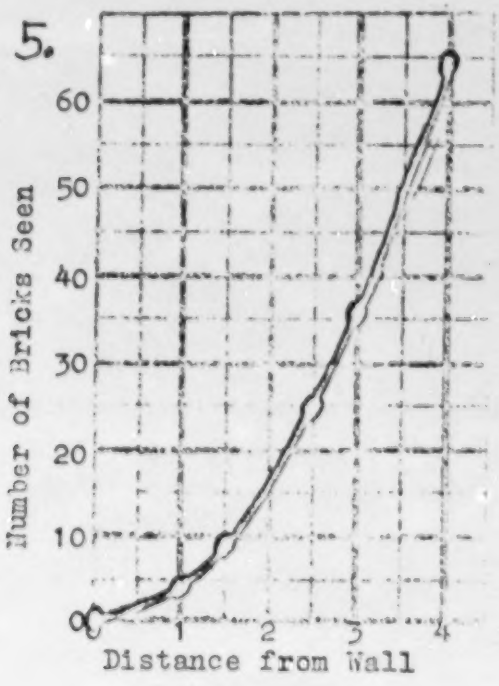
3.



4.



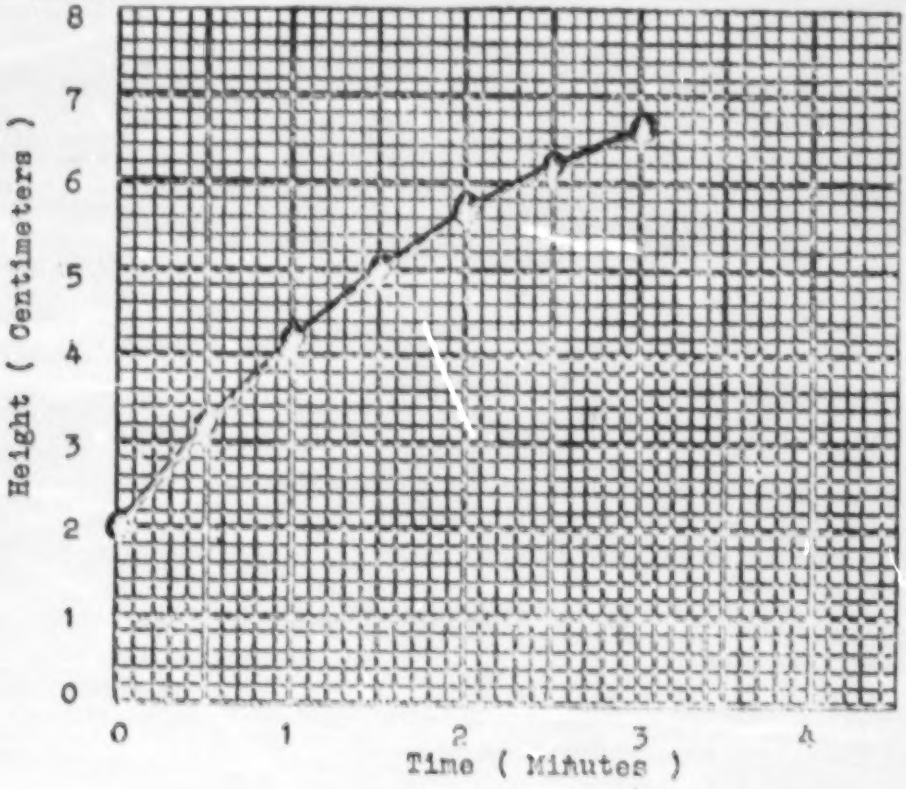
5.



1. Graphs 1 and 4
2. Graphs 2 and 3
3. Graphs 2 and 4
4. Graphs 2 and 5
5. Graphs 1 and 5

Make predictions from the plotted line or curve on a graph.

22. In an experiment on the expansion of water, a student recorded the changing heights of a water column that was slowly rising from being heated. The height was recorded every thirty seconds and a complete graph of the data is shown below.

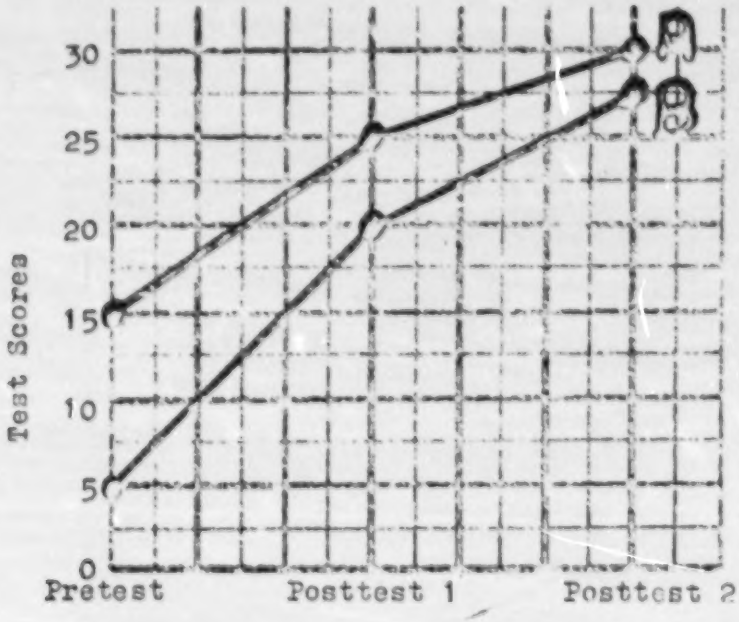


On the basis of the above data, predict the height of the water column at the end of four minutes of expansion.

1. 7.8 cm
2. 7.4 cm
3. 7.0 cm
4. 6.8 cm
5. 6.6 cm

Make comparisons such as greater than, less than, or the same as with curves or lines plotted on a graph.

23. In an experiment on learning, two students were given a pretest on a set of Latin names for animals. After the pretest, the students were given time to study the Latin names and their english equivelents. This study period was foll wed by another test or posttest 1. In similar fashion, after another period of study the stud nts received posttest 2. The test scores for student " A " and student " B " are shown in the graph below.

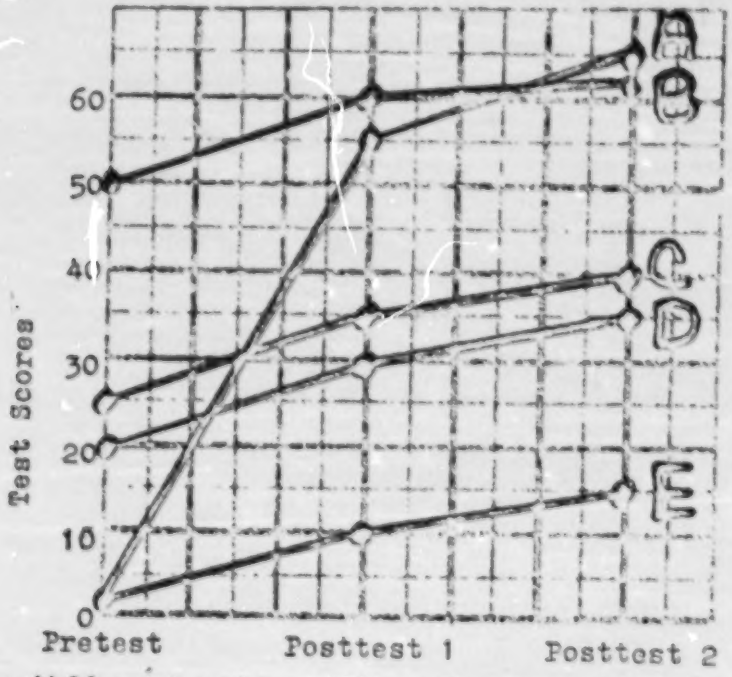


Which of the following statements concerning student " A " and student " B " is true?

1. Student B has learned more than student A. (Total)
2. Student B has learned the same amount as student A. (Total)
3. Student A has learned more than student B. (Total)
4. Student A knew less than student B after the pretest. (Total)
5. None of these .

Identify rates of change from curves plotted on a graph.

24. In an experiment on learning, five students were given a pretest on a set of Latin names for animals. After the pretest, the students were given time to study the Latin names and their English equivalents. This study period was followed by another test or posttest 1. The experiment continued exactly in the same manner as described in question twenty-three. The test scores for students " A ", " B ", " C ", " D ", and " E " are shown in the graph below.



How many different rates of learning are shown in the above graph between the pretest and posttest 1?

1. zero rates of learning
2. 1 rate of learning
3. 2 rates of learning
4. 3 rates of learning
5. 4 rates of learning

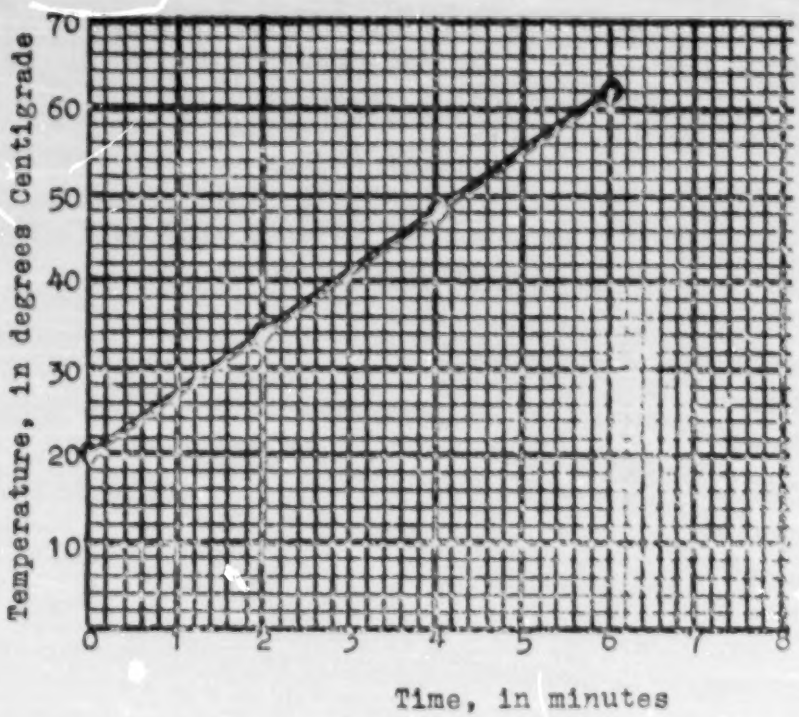
Make comparisons between rates of change represented on a graph.

25. Which student from the experiment described in question 24 was the fastest learner?

    1. Student A
    2. Student B
    3. Student C
    4. Student D
    5. Student E

Calculate the rate of change from lines plotted on a graph.

26. In an experiment on heat capacity, a student used an immersion heater to warm up 400 ml of water. The temperature in degrees centigrade was recorded every two minutes. The results are shown in the graph below.



1. (5, 4, 4)
2. (4, 4, 5)
3. (3, 4, 4)
4. (4, 5, 4)
5. (4, 3, 1½)

Locate points on a three-dimensional coordinate system given the coordinates.

28. What point is located at (7, 4, 3) ? See preceding graph.

1. Point F
2. Point H
3. Point G
4. Point F
5. Point B

Calculate the temperature rise in degrees per minute. The temperature of the water at the start of the experiment was 20 degrees centigrade.

1. 14 degrees per minute
2. 16 degrees per minute
3. 13 degrees per minute
4. 7 degrees per minute
5. 9 degrees per minute

Determine the coordinates of points located in a three-dimensional coordinate system.

27. Determine the coordinates of point E in the graph below.